# The UK Hydrogen Innovation Opportunity

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Hydrogen Innovation Initiative



Our mission is to accelerate critical technologies and supply chains in the UK for the fast-growing global hydrogen economy.

HII is working with >200 companies and 10 sector bodies in the UK, to coordinate innovation in 9 critical technology areas across:



HII is working with industry to drive innovation and supply chain development, working across UK industry and with support from our Industrial Advisory Board:

bp, Airbus, Cummins, GKN Aerospace, Glass Futures, H2Go, Hydrogen Energy Association, Hydrogen UK, Johnson Matthey, National Gas, ZeroAvia

HII is generating **technology roadmaps**, forecasting **sector demand** and **markets**, and mapping **UK capability**.

#### HII partners:



#### Our partners are supporting industry to accelerate the hydrogen economy....





# Unlocking the benefits Anchoring the value

The UK Hydrogen Innovation Opportunity





### The global hydrogen economy



When both direct and indirect economic benefits are considered, the global hydrogen economy has the potential to be worth \$8 trillion by 2050.

#### **Direct and indirect economic activity**

#### 3 x benefits: Decarbonisation – Economic – Influence







### Hydrogen technology market

# **1** trillion

#### **9 cross-cutting hydrogen technology families**

#### Target a 10% market share of the global market





The UK is starting from a strong base of industrial capability with an established innovation ecosystem. Under the right conditions and with the right strategic investments, this can be catalysed for growth.

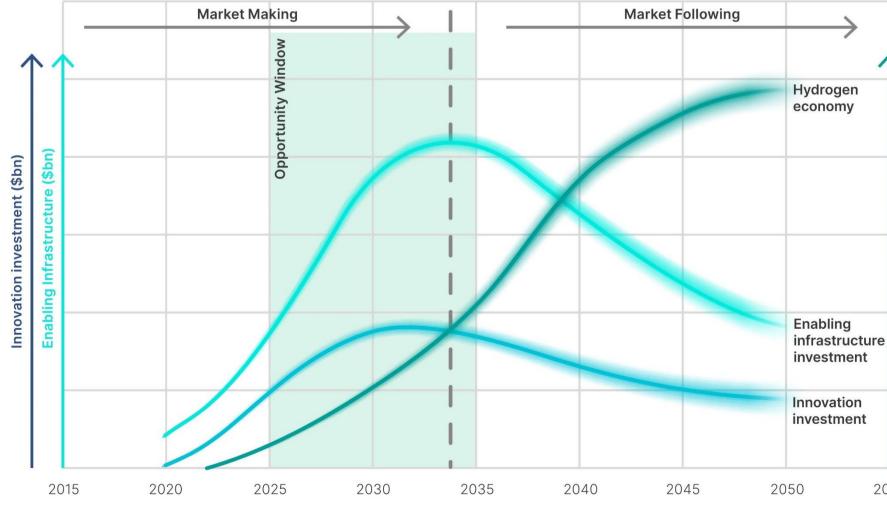


### Window of opportunity

#### To secure a market leading position

Capturing the expected peaks for innovation and infrastructure investment, along with highest growth phase of the global hydrogen economy

# **L years**





If the UK is to stay ahead of international competition a strategic approach to investment in hydrogen innovation must be developed and delivered at pace.

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2055

### **Strategic intervention**

#### **Representing biggest potential for the UK**

Production of hydrogen and conversion into carriers

Propulsion systems for transport

Industrial hydrogen for feedstock, heat and power

End-to-end hydrogen storage

# Focus areas

The UK Hydrogen Innovation Opportunity

Innovation creating a space for us to become truly world leading...



### The UK Hydrogen Innovation Opportunity in figures



# \$8 trillion

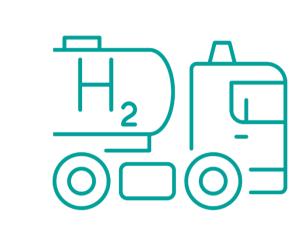
The global hydrogen economy in 2050, considering direct and indirect economic activity



Global hydrogen technology market by 2050 Delivered by 9 cross-cutting technology families





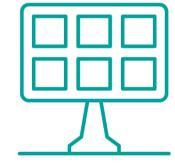




# 4 areas of focus

Representing the biggest areas of potential for the UK

### 10 year window



To secure our position as market maker



### The UK Hydrogen Innovation Opportunity and supporting reports



The UK Hydrogen **Innovation Opportunity** 

**UK Capabilities** 



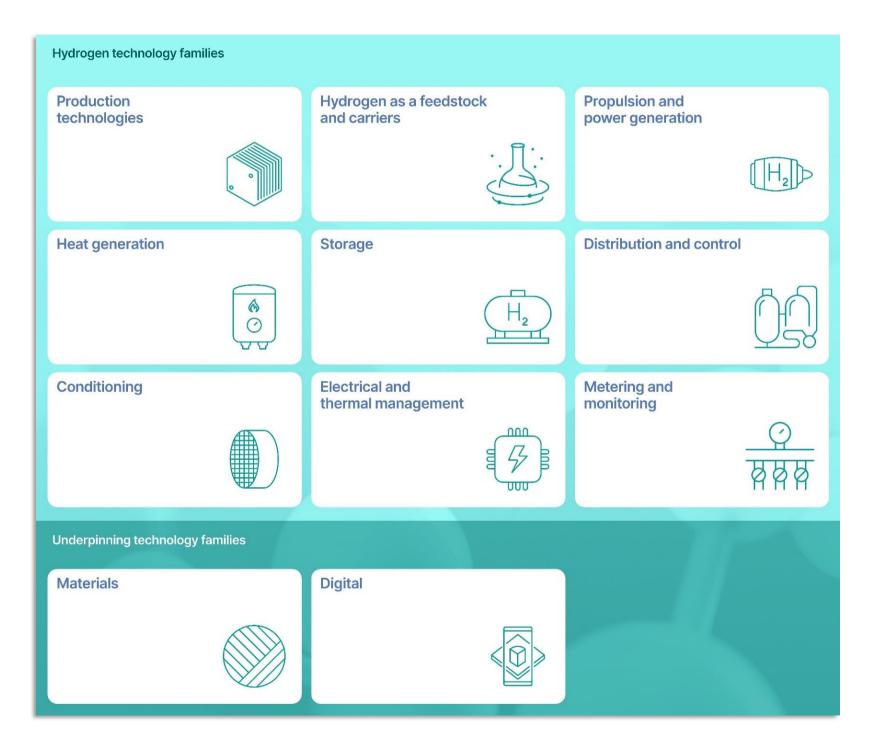
The UK Hydrogen **Innovation Opportunity** 

Techno-economic methodology



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### The UK Hydrogen Innovation Opportunity – Hydrogen technology roadmaps





#### Propulsion and power generation

Summary: Three propulsion technologies will see ural deployment into key sectors. Fuel cells and enal combustion engines are typically suited medium to high-duty demands with long-range uirements and where refuelling can be centralis t key hubs, such as Heavy Good Vehicles (HG) nd coaches. This is reliant on the availability of fuelling infrastructure and the technology be cost competitive with battery electric vehicles. Fue cells could also see migration into more demanding applications, such as short-range flight, but require

#### Fuel cells

Current state: Many fuel cell technologies are mature and readily available. Development is needed to improve durability and efficiency such as through novel hightemperature Proton Exchange Membrane (PEM) fuel cells

#### Gas turbines

Current state: Hydrogen gas turbine technology maturit varies depending on the blend of hydrogen. Low hydrog concentrations using existing gas turbine designs are the mature with existing designs thought to be suitable. Furthe development is required for higher hydrogen concentration

#### Internal combustion engines

Current state: Hydrogen internal combustion engines are being matured, with several leading manufacturer bringing products to market; other manufacturers are also developing solutions. Activity is required to improve performance and increase competitiv

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#### The UK Hydrogen Innovation Opportunity



# ×9 technology roadmaps

2050

UK Global

\$5.25bn £150bn

step change in technology to improve performance and reliability. Direct combustion of hydrogen is seen as a					Global and UK market forecasts These tables show forecasts for the annual global				2030		
Tensionly binection factor internal combustion engines, with natural transition for internal combustion engines, with the key advantage being minimal change to the existing technology and supply chains. Direct combustion of hydrogen through turbines is seen as a possible method to decarbonise higher power applications, such as power generation or short-medium haul flights. Hydrogen combustion processes need to be managed to minimise other emissions such as NO <sub>2</sub> .				and UK market for this technology family. The figures show the neutral (midpoint) scenario from analysis for HII by Markets and Markets [1].				UK \$0.12bn	Global \$8bn		
Managed to Ma		2025	2026	2027	2028	2029	2020	202	5 20	10	

	Now	2025	2026	2027	2028	2029	2030	2035	2040	2045	2050	
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i.		to increa	d integration of b se efficiency ar	d reduce cost	m equipment	0						
	High tempe	erature/efficient	fuel cells reduci	ng mass and inc	reasing operatin	ig life		0		( SIS		
	Durable lor	ng life fuel cells a	nd membranes,	able to withstar	d impurities and	harsh environme	ents	🙆				
		efficient use of a such as critical ra				lise critical		🙆				
	Incrementa	al solutions using	modification to e	existing designs	to improve dura	bility @ <100% h	lydrogen					
n most	Material an	d monitoring solu	utions for combu	stion to improve	e durability @ 10	0% hydrogen		0				
ier ons.		d operational para pacting efficient				0						
	Improve pe	erformance of re	trofittable hydro	gen and dual fue	el engines						88	
	Improve ef	ficiency through	optimising hydro	ogen combustio	n and waste hea	t recovery	0					
	Reduction	of NO <sub>x</sub> emission:	s through develo	pment of impro	ved abatement s	ystems	0					
	KEY: Tech	nology Developm	ent o		Technology In	dustrialisation –	0		Hydrogen	technology r	oadmaps 20	



### The UK Hydrogen Innovation Opportunity – UK capabilities

#### An accelerating UK hydrogen technology supply chain



Essar Energy Transition Hygen HYRO Locogen Progressive Energy
OCK Storengy Cadent Gas National Gas National Grid NGN
Ricardo Wood Group wsp
2G AFC Energy Airbus Ballard Motive Solutions CAT
JCB Tevva Toyota ULEMCo Wrightbus ZeroAvia
skel Logan Energy Lux Industries
gy Wild Hydrogen Catagen OXCCU Reaction Engines
Engines Cummins DAF Intelligent Energy ITP Aero Perkins
Trent Refractories Chesterfield Specialist Cylinders Glacier Energy
AVK Eaton FT Pipeline Systems Fusion Systems Liberty Steels
stech Belliss & Morcom Edwards CTI Cryogenics Haskel Howden
GM Flow HyMet Oxsensis Servomex Synthotech
·····
at generation Storage
Metering and monitoring Mixed



# The routes to success are now clear but the window of opportunity is fast reducing. Now is the time to unlock the UK hydrogen innovation opportunity.

The UK Hydrogen Innovation Opportunity





### Download the UK Hydrogen Innovation Opportunity now

hydrogeninnovation.co.uk



Hydrogen Innovation Initiative



#### Hosted by:



#### Innovate UK and EPSRC



Hydrogen Innovation Initiative



Hydrogen Integration for **Accelerated Energy Transitions** 



### **Hydrogen Innovation Showcase**



# 2-3 July 2024

Pendulum Hotel in Manchester **Day 1:** Innovation pitch session, facilitated networking and drinks **Day 2:** Keynote presentations from industry leaders, Parallel sessions focused on making, moving an using hydrogen And more to be announced

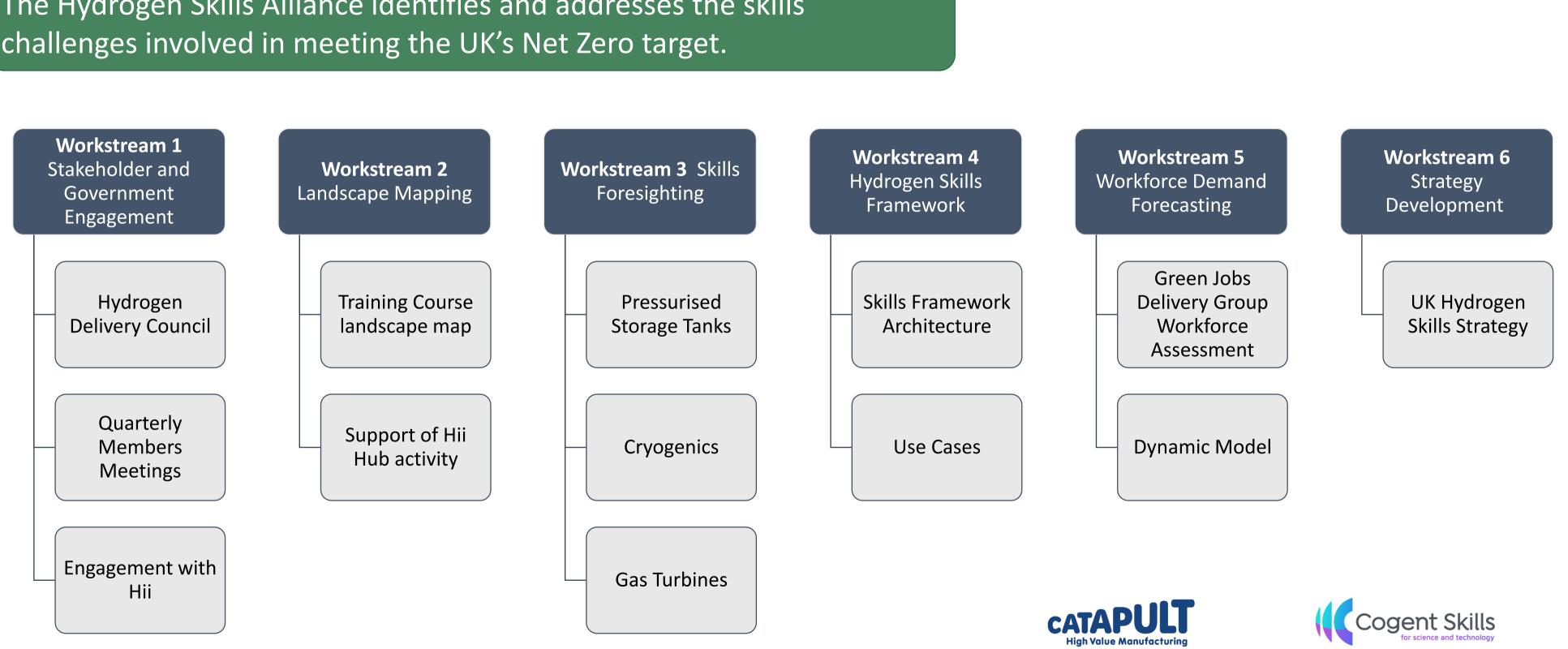
# **Event focus**

The Hydrogen Innovation Initiative, Innovate UK and the EPSRC Hydrogen Hubs, UK-HyRES and HI-ACT, have come together to host the Hydrogen Innovation Showcase. This event will highlight the innovative projects taking place across the UK hydrogen value chain, featuring key players in the hydrogen landscape.



### Hydrogen Skills Alliance

The Hydrogen Skills Alliance identifies and addresses the skills challenges involved in meeting the UK's Net Zero target.





Contact george.jenkins@nccuk.com for more information or to get involved

# Get in touch:

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#### HII partners







